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CONTENTS

A STUDY OF ANDEAN SPINNING IN THE CUZCO REGION.
Miss Grace Goodell 2

HANDSPUN YARN PRODUCTION RATES IN THE CUZCO REGION OF PERU.
Junius B. Bird 9

KIRMAN'S HERITAGE IN WASHINGTON:
VASE RUGS IN THE TEXTILE MUSEUM. *Charles Grant Ellis* 17

CHINESE RUGS. *Charles Grant Ellis* 35

PRINCIPLES OF TEXTILE CONSERVATION SCIENCE, NO. IX
How Humidity May Affect Rug, Tapestry, and Other Textile Collections.
James W. Rice 53

PRINCIPLES OF TEXTILE CONSERVATION SCIENCE, NO. X
An Investigation Into Cleaning and Conservation of Mixed Leather
And Fiber Artifacts. *James W. Rice* 57

TEXTILE MUSEUM NOTES 61

BOARD OF TRUSTEES AND STAFF OF THE TEXTILE MUSEUM 64

COVER: *Three women spinning yarn at Chincheros; woman seated at left with a backstrap loom,* illustration for "A Study of Andean Spinning in the Cuzco Region" by Miss Grace Goodell. Photograph by Alan R. Sawyer.

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PRINCIPLES OF TEXTILE CONSERVATION SCIENCE NO. X

AN INVESTIGATION INTO THE CLEANING AND CONSERVATION OF MIXED LEATHER AND FIBER ARTIFACTS

JAMES W. RICE

A Tsimshian Indian blanket of mountain goat wool, mountain goat wool-cedar bark composite yarn warp and fringe, with leather warp cord and leather and fur bindings at the top, was drycleaned on January 16, 1964 by the writer at the Institute Cleaning Plant of Silver Spring, Maryland.[1] This specimen, Figure 1, which is probably dated from about 1830, may never have been cleaned before and was darkly soiled with an accumulation of gray, soot-like, finely divided material. The fringe was especially dirty and the leather bindings were stiff and hard. Because of this condition, it was decided that drycleaning by a special hand method would be best.

The following system was employed:

First, an emulsion of one part water, three parts "ADCO'S Triple X Dry-sheen" anionic drycleaning detergent, which is reputed to have good leather softening as well as cleaning properties, was stirred until it was clear.

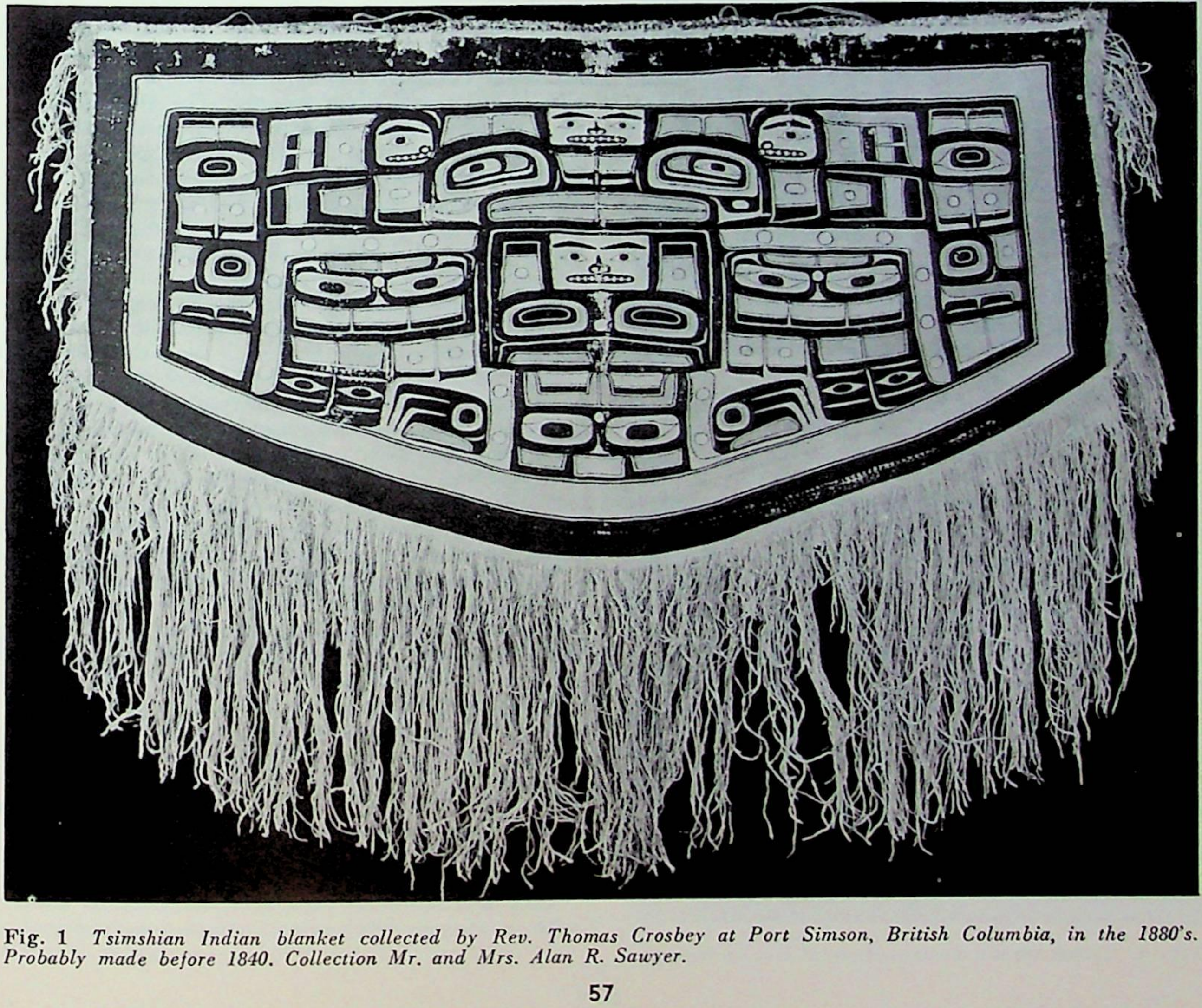

Fig. 1 *Tsimshian Indian blanket collected by Rev. Thomas Crosbey at Port Simson, British Columbia, in the 1880's. Probably made before 1840. Collection Mr. and Mrs. Alan R. Sawyer.*

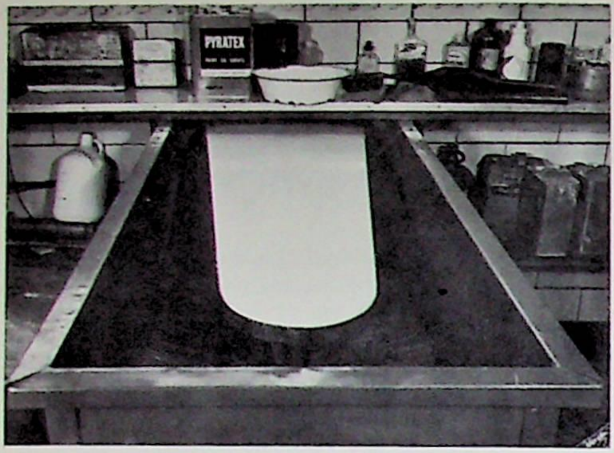

Fig. 2 *A prespotting board.*

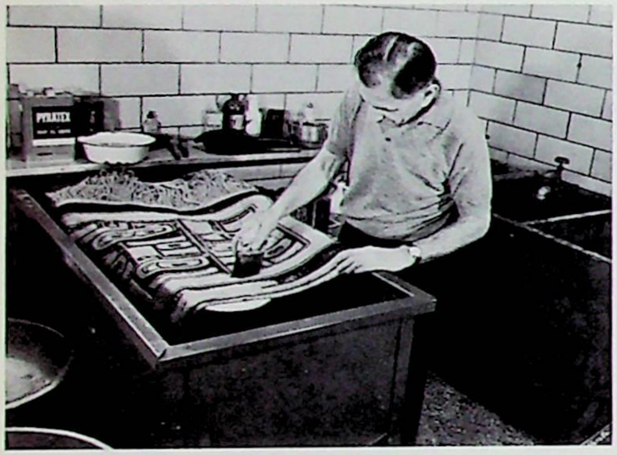

Fig. 3 *Drycleaning detergent mixture applied to a Chilcat blanket by stippling and tamping with a paint brush.*

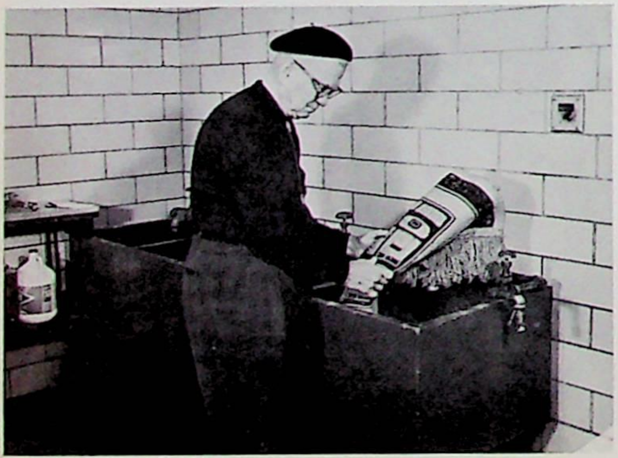

Fig. 4 *Chilcat blanket being transferred to a rinsing tub.*

Second, the specimen, which is about two and one-half feet long with a fringe about twenty inches long and about five feet wide was laid out on a prespotting board face down, Figure 2. The exposed back, leather parts and fringe were saturated with the drycleaning detergent mixture applied by stippling or tamping gently with a four-inch soft, paint brush, as is shown in Figure 3. The mixture was applied to the front face in the same way. In all, about 2½ gallons of the mixture were used for this purpose.

Third, the saturated specimen was transferred to a tub containing about 20 gallons of clean Stoddard solvent. (Figure 4) This rinse contained a good deal of soil. Three more rinses were given until the last one was substantially clear.

Fourth, the specimen was next lifted above the tubs onto a screen where it was drained for about fifteen minutes.

Although still wet with solvent, the blanket was pinned by means of a cotton tape binding along the top to hangers and suspended in a drying cabinet where a current of air at 125° F. was flowing. (Figure 5) Drying was continued for about eighteen hours.

On removal from the drying cabinet, the specimen was examined for appearance and condition. Much soil removal was apparent. The leather parts were cleaner and a little softer. The textile yarns were faintly harsher than before cleaning but this was attributed to the fact that the fabric had not had time to regain its natural moisture content after exposure to a long period of hot very dry air. It was hoped that patient exposure to naturally humidified air would correct this harshness in time.

From this and other experiences with leather, and expecially with textiles containing hazardous dyes, drycleaning promises a safe and satisfactory way of soil removal.

After the Tsimshian Indian blanket was cleaned, it was sent out on loan for an exhibition and since that time has been hanging in the office of the Director of the Textile Museum without any particular further study until just recently. However, now, without any comparison criteria other than our memory, it seems to be nearly in the same condition as when we finished working with it, over four years ago, except that the leather thongs may be slightly less flexible than when the blanket was examined just after cleaning. With this in mind, we decided to look into possible improvements in our method of processing and the reagents that were used. These, although not referred to in our previous report in *Studies in Conservation* [2], were based on standard leather cleaning practice but modified to suit this particular problem.

Our choice of cleaning method was a variation of a routine for cleaning leather taught at the National Institute of Drycleaning School.[3] In brief, this system consists of the following steps:

Step 1. The item is prespotted and brushed down with a strong drycleaning detergent-water-drysolvent solution. According to our particular experi-

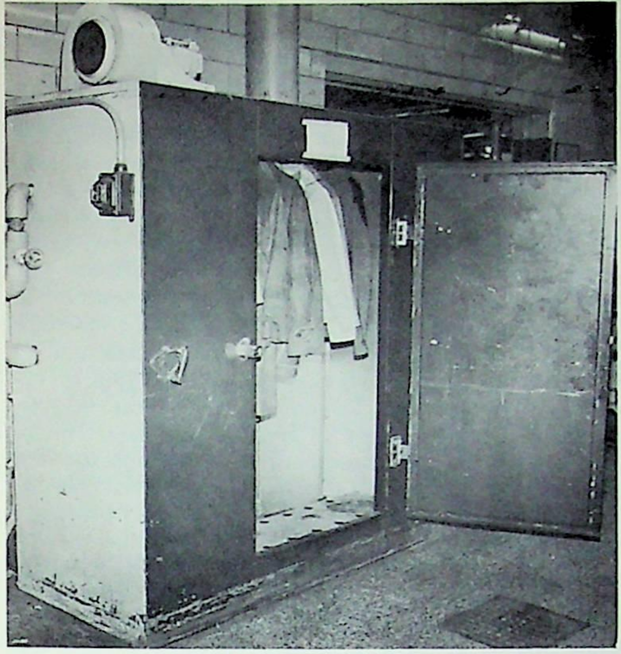

Fig. 5 *A typical drying cabinet.*

ence and thinking, this was expected to help penetrate the leather and carry some lubricant into its interior structure. The prespotting is supposed to attack some otherwise difficult to remove soils. (See Figure 3)

Step 2. After a time to allow for penetration, the item is transferred to a washing machine much like the one shown in the center of Figure 6, where it is tumbled slowly by reversing action in a solution of drycleaning detergent-water mixture added to form a concentration of about 1½%, in a petroleum solvent of special characteristics. During this tumbling, the solvent is continuously replaced and filtered in equipment such as is shown to the right in Figure 6. Admittedly, the tumbling action is not appropriate for some leather items such as book bindings.

The tumbler and filter system, shown in the illustration, is representative of the type of equipment which we think can be adapted to conservation work because it can be used for mere soaking and continuous changing of the cleaning media.

In the Indian blanket problem, we did not employ this system because the specimen was far too fragile to withstand such vigorous mechanical action.

Step 3. After cleaning and rinsing in the tumbler, ordinary commercial leather garments are transferred to a centrifuge for removal of excess liquid. A large 36-inch type centrifuge revolving at 900 R.P.M. does this rapidly. This equipment is shown to the left in Figure 6. For leathers, which are considered to be strong and which release liquids reluctantly, the operating time is usually five minutes. For the Indian blanket we substituted draining over a long period instead. We also absorbed some of the excess liquid by towels.

Step 4. For drying, commercial work is usually tumbled in air at room temperature for about 10 minutes to relax wrinkles and creases incidental to the centrifugal pressures. Equipment for this is not shown, as we believe it to be generally too drastic and we do not recommend its use for museum conservation work.

Step 5. In the second stage of drying, the work is transferred to a drying cabinet where it is exposed to a current of warm air at about 120° F. (Figure 5) In commerical work, the expouse time is about one-half hour after which garments are suspended in the open cleaning room until completely deodorized. With the Indian blanket, which contained much more solvent, this time was longer. However, this probably did not affect the condition of the garment adversely because there is very, very little oxidation under solvent-air contact at this temperature. If the leather were wet with water alone, there would have been oxidation and perhaps additonal hardening and cracking of its surfaces.

There are several reasons why drycleaning of leather articles is safer and more widely accepted in commercial practice than wet cleaning. First, when saturated with water, leather swells. Its dense compact structure prevents even rapid drying, so wrinkling and cracking of the smooth or grain side usually occurs. As it dries, stiffening and hardening results and there is a great danger of irrecoverable shrinkage accompanied by even greater hardening if the leather is heated during the drying phase. If treated with live steam, this damage takes place immediately.

When drycleaning with due professional expertise, these shrinkage and hardening factors are minimized and, although some shrinkage and stiffening may occur, the leather may be relaxed by careful processing and choice of cleaning and preserving additives either during or after the processing.

To be in a satisfactory condition, leather must be flexible. The flexibility depends on two main factors: first, the natural moisture content of the fibers themselves and, second, the more or less inert lubri-

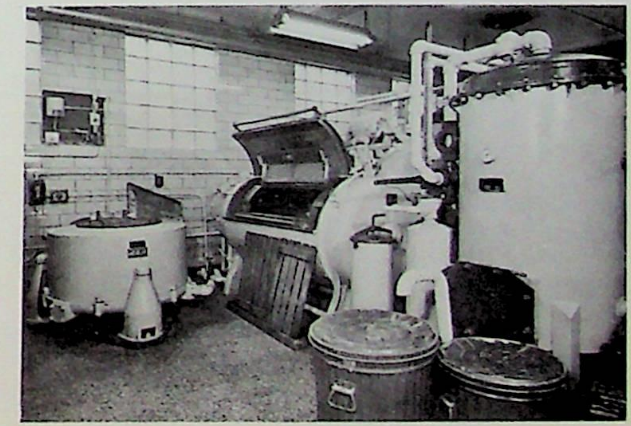

Fig. 6 *Typical equipment for cleaning. From left to right: (a) Centrifugal extractor, (b) large slow speed washing machine, and (c) large capacity solvent filter.*

cants protecting the fibers. As a general assumption, one may suppose that the fibers are hygroscopic and will vary in moisture acceptance or retention according to the air relative humidity to which they are exposed. This moisture exchange may be very much slower than in a woven textile and possibly is affected by the density of the leather structure and the amount of protective lubricant coating around the interior fibers.

One of the important operations in the manufacture of leather is the "Fat Liquoring" procedure in which an emulsion of oils in water is applied. It is the last of the wet processing operations and its purpose is to provide lubrication to the fiber mat. These lubricating oils are very soluble in drysolvents and unless great care is taken they are removed in the cleaning process. For this reason the solvent is generally loaded with a mixture of oils and emulsifiers which contribute very little to the cleaning but which the cleaner hopes to deposit back into the leather to balance the lubricant which would be lost. In the system that was briefly described, the excessive amount of drycleaning detergent which was used in the first operation was designed to replace any oils that might be removed. It should be recalled that lubricants are related to drycleaning detergents.[4] Some recent experimental work at the National Institute of Drycleaning, which has not yet been published, but which we were permitted to study, indicates that the system as described does not remove a significant weight of the lubricant. In this case, it should be noted that the drycleaning detergents are very long chain hydrocarbons with definite surface activity properties and a limited amount of ability to attract and retain moisture at the hydrophyllic end. Perhaps the crude diagram in Figure 7 will illustrate this theory.

Fig. 7 *A schematic representation of a drycleaning detergent:*

——————————————— *-0-0*

carbon chain *24 C's* *hydrophylic end*

hydrophobic end

Since the surface active properties of these long chain molecules are very much like lubricants, they may be expected to cling to the interior fibers and serve that purpose. We would also expect them to provide some humecticant properties towards maintaining a reasonable natural moisture content.

From this reasoning, we now believe that the excessive amount of rinsing of the Indian blanket may have removed too much of the lubricant-humecticant strong detergent solution that we labored so hard to put into the leather thongs in the first operation. This may account for the lack of complete success in softening as we see it today. (A humecticant is a moisturizing additive such as glycerin, but in this case we must choose one that has solubility in drysolvent in which glycerin is insoluble.)

It is possible that fat liquoring of "stuffing" with various mixtures and saddle soaps such as the British Museum leather conservation formula[5] or in the U.S.D.A. Leaflet No. 398[6] may provide the necessary lubrication after cleaning more successfully. In this case a prior treatment with saddle soap may also produce some beneficial humidification which will however not be lasting.

In conclusion, it is our belief that additional research in the areas of humidification, lubrication and protective bacteriocidal treatments would benefit conservation of leather.

In this connection, there are at least five areas where standards for comparison of effects are needed. These are: 1. Drying out of the leather. 2. Hardening of the leather. 3. Shrinkage. 4. Surface cracking. 5. Interior decomposition. When and if these standards are investigated and adopted or approved, we will then be able to overcome maintenance and replacement of hygral qualities, softening, interior and surface stability and degradation.

In the meantime, specific possibilities as to improvement in the cleaning of leather as practiced by industry are:

1. The cleaning fluid that combines soil removal with the least loss of interior lubrication appears to be a petroleum distillate solvent type with a moderately low K-B (kouri-butanol) number.[8] This author's guess as to the correct number is that it should be about K-B 35. A mixture of Stoddard Solvent (Flash point 105) and 140° Solvent in equal parts may produce this point.
2. An investigation of the best drycleaning detergents with specific properties of providing for the most effective moistening and lubrication effects as mentioned previously.
3. Perhaps we should try to find some way of neutralizing or buffering the supposed tendency of some leathers to become more acid with age as reported by Rogers and Beebe.[6] A possibility might be in investigating the employment of solvent soluble cationic surfactants of long carbon chain quatro ammonium types which might be soluble in drysolvents.[7]

NOTES

[1] The Institute Cleaning Plant is a subsidiary of National Institute of Drycleaning, 909 Burlington Avenue, Silver Spring, Maryland.

[2] James W. Rice. A Drycleaning Technique for Textile Conservation in *Studies in Conservation*, Vol. 9, No. 3, pp. 83-90, August 1964.

[3] Tips o Handling Leathers, Nos. 51-52 of *Practical Operating Tips* published by National Institute of Drycleaning, January 1962, also Cleaning Leather Garments Using Fat Liquor, No. 85 of *P.O.T.*, January 1968.

[4] James W. Rice. Characteristics of Detergents for Cleaning Historic Textiles, in Principles of Textile Conservation Science No. VII, *Textile Museum Journal*, Vol. II, No. 3. pp. 29-30. 1966.

[5] H. J. Plenderlieth. *The Conservation of Works of Art*. Chapter I, Appendices IX and X.

[6] J. S. Rogers and C. W. Beebe. *Leather Bookbindings, How to Preserve Them*, Leaflet No. 398. U.S. Department of Agriculture, U.S. Printing Office, 1958.

[7] James W. Rice. Characteristics of Detergents for Cleaning Historic Textiles, in Principles of Textile Conservation Science, No. VII, *Textile Museum Journal*, Vol. II, No. 3, p. 36. 1966.

[8] L. Shieflan and M. B. Jacobs, *The Handbook of Solvents*, 1953, pp. 31-33. D. Van Nostrand Co., Inc.